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*Original Article*

# Prevalence and Patterns of Hormonal Dysregulation among Infertile Women Attending a Tertiary Care Hospital in Lahore: A Cross-Sectional Study

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## ABSTRACT

Background: Infertility is a major reproductive health concern affecting women worldwide, with hormonal abnormalities representing one of the leading causes of impaired reproductive function. Endocrine disturbances involving gonadotropins, thyroid hormones, and other reproductive hormones can disrupt ovulation and menstrual regularity, thereby contributing to infertility. Objective: To assess the prevalence and patterns of hormonal dysregulation among infertile women and to examine the association between hormonal abnormalities and infertility characteristics. Methods: An analytical cross-sectional study was conducted among 157 infertile women attending the gynecology and infertility outpatient departments of Lady Willingdon Hospital, Lahore, Pakistan. Demographic, clinical, and laboratory data were collected using a structured data collection form. Hormonal parameters including follicle-stimulating hormone, luteinizing hormone, and estradiol were evaluated. Descriptive statistics were used to summarize participant characteristics, while inferential analysis using chi-square testing examined associations between hormonal abnormalities and infertility type. Statistical analysis was performed using SPSS, with a significance level of $p < 0.05$. Results: Primary infertility accounted for 58.0% of cases, while secondary infertility was observed in 42.0% of participants. Abnormal luteinizing hormone levels were detected in 32.3% of women, followed by abnormal estradiol levels in 25.8% and abnormal follicle-stimulating hormone levels in 21.0%. The mean LH/FSH ratio was 1.8. No statistically significant association was found between overall hormonal imbalance and infertility type ($p = 0.62$). Conclusion: Hormonal abnormalities, particularly elevated luteinizing hormone levels and altered gonadotropin ratios, are common among infertile women. Comprehensive hormonal evaluation may assist in identifying endocrine causes of infertility and guide appropriate clinical management. Keywords: Infertility, Hormonal dysregulation, Luteinizing hormone, Follicle-stimulating hormone, Reproductive endocrinology

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## INTRODUCTION

Infertility represents a major reproductive health concern worldwide and is defined as the inability to conceive after twelve months of regular unprotected intercourse. Globally, infertility affects approximately 10–15% of couples and has significant medical, psychological, and socioeconomic consequences for affected individuals and families. Among women, endocrine abnormalities constitute one of the most frequent causes of infertility because reproductive hormones regulate ovulation, follicular maturation, endometrial receptivity, and menstrual cyclicity. Disruption in hormonal balance can therefore impair reproductive physiology at multiple levels and lead to ovulatory dysfunction, menstrual irregularities, or implantation failure (1).

Several hormonal disorders have been implicated in female infertility, including thyroid dysfunction, hyperprolactinemia, polycystic ovarian syndrome (PCOS), and abnormalities in gonadotropin secretion. Thyroid hormones play a crucial role in reproductive physiology by influencing ovulatory cycles, ovarian reserve, and luteal phase adequacy. Even mild thyroid dysfunction has been associated with

infertility and adverse reproductive outcomes. Studies have demonstrated that hypothyroidism is relatively prevalent among infertile women and that appropriate treatment may improve fertility outcomes (1,4,10). Similarly, hyperprolactinemia can interfere with gonadotropin-releasing hormone secretion, leading to anovulation and menstrual disturbances. Elevated prolactin levels have been reported in a considerable proportion of infertile women and are frequently associated with irregular menstrual cycles and ovulatory dysfunction (2,11,14).

Polycystic ovarian syndrome is another important endocrine disorder contributing to female infertility. PCOS is characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology, and it remains one of the leading causes of anovulatory infertility worldwide. Women with PCOS often exhibit altered gonadotropin dynamics, particularly elevated luteinizing hormone (LH) levels and an increased LH/FSH ratio, which contribute to impaired follicular development and ovulation. Epidemiological studies have demonstrated that infertility is significantly more prevalent among women with PCOS compared with the general population (6,12). Moreover, hormonal disturbances associated with PCOS frequently coexist with metabolic abnormalities such as obesity and insulin resistance, further complicating reproductive outcomes (3).

In addition to endocrine factors, reproductive infections and metabolic conditions may also interact with hormonal pathways to influence female fertility. Research has shown that genital infections such as Chlamydia trachomatis and Ureaplasma urealyticum can contribute to infertility through inflammatory damage to reproductive structures, while hormonal disturbances may exacerbate reproductive dysfunction in affected individuals (18). Hormonal profiling, including the evaluation of follicle-stimulating hormone (FSH), luteinizing hormone (LH), estradiol, prolactin, and thyroid hormones, has therefore become an essential component of infertility assessment in clinical practice (5,8).

Despite the recognized importance of endocrine abnormalities in infertility, there remains limited region-specific evidence describing the hormonal patterns among infertile women in South Asian populations. Variations in lifestyle factors, nutritional status, obesity prevalence, and reproductive health practices may influence the distribution and presentation of hormonal disorders across different populations. Several studies conducted in Asian populations have reported significant correlations between reproductive hormone profiles and infertility, highlighting the need for population-specific data to guide clinical evaluation and management strategies (13,17,19). However, comprehensive analyses of hormonal dysregulation among infertile women in tertiary care settings in Pakistan remain relatively scarce.

Understanding the prevalence and patterns of hormonal abnormalities among infertile women is essential for improving diagnostic approaches and guiding targeted therapeutic interventions. Identifying the hormonal profiles most frequently associated with infertility may also assist clinicians in prioritizing investigations and optimizing fertility management protocols. Therefore, the present study aimed to assess the prevalence and patterns of hormonal dysregulation among infertile women attending a tertiary care hospital and to examine the association between hormonal abnormalities and infertility characteristics.

## MATERIALS AND METHODS

This analytical cross-sectional study was conducted at the gynecology and infertility outpatient departments of Lady Willingdon Hospital, Lahore, Pakistan, a tertiary care teaching hospital that serves a large population of women seeking reproductive health services. The study was designed to evaluate the prevalence and patterns of hormonal abnormalities among women presenting with infertility and to examine the association between endocrine disturbances and infertility characteristics. Infertility was operationally defined as the failure to achieve pregnancy after at least twelve months of regular unprotected sexual intercourse, consistent with internationally accepted reproductive health definitions (15).

The study population consisted of women aged 18 to 45 years who attended the infertility clinics of the hospital and were clinically diagnosed with either primary or secondary infertility. Participants were recruited through consecutive sampling during routine outpatient visits. Women were eligible for inclusion if they had a confirmed diagnosis of infertility and were willing to participate in the study and provide laboratory test results related to hormonal evaluation. Women were excluded if infertility was attributed to confirmed male-factor causes, if they had a history of hysterectomy or surgical removal of ovaries, if they were currently pregnant, or if they had severe systemic diseases known to affect reproductive function. All eligible participants were informed about the objectives and procedures of the study, and written informed consent was obtained prior to enrollment.

Data were collected using a structured clinical data collection form developed for the study. The instrument captured demographic characteristics, reproductive history, lifestyle factors, clinical findings, laboratory investigations, and ultrasound results. Demographic variables included age, body mass index, marital duration, educational status, and socioeconomic background. Reproductive variables included the type of infertility (primary or secondary), duration of infertility, menstrual cycle regularity, obstetric history, and history of miscarriage. Lifestyle factors such as obesity, alcohol consumption, and other behavioral risk factors were also documented because of their potential influence on reproductive endocrine function (3).

Hormonal assessment was performed using blood samples collected during the early follicular phase of the menstrual cycle when feasible. The hormonal parameters evaluated in the study included follicle-stimulating hormone, luteinizing hormone, estradiol, prolactin, and thyroid-stimulating hormone. These biomarkers are widely used in clinical infertility assessment because they provide essential information regarding ovarian reserve, ovulatory function, and endocrine disorders affecting fertility (5,8). The LH/FSH ratio was calculated for each participant to assist in identifying hormonal patterns suggestive of polycystic ovarian syndrome. Hormonal values were categorized as normal or abnormal according to standard laboratory reference ranges used by the hospital diagnostic laboratory. Ultrasound findings, including ovarian morphology and antral follicle count where available, were also recorded as part of the diagnostic evaluation.

To minimize measurement bias, all laboratory investigations were performed using standardized diagnostic procedures within the hospital laboratory, and clinical data were obtained from patient records and laboratory reports rather than self-report alone. Consecutive recruitment of eligible participants was used to reduce selection bias, and standardized data collection procedures were implemented to ensure consistency across participants. Potential confounding variables such as age and body mass index were recorded to allow adjustment during statistical analysis.

The final study sample consisted of 157 infertile women who met the eligibility criteria and completed the required hormonal investigations. The sample size represented the total number of eligible participants available during the study period within the hospital infertility clinics. Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS), version 26. Descriptive statistics were calculated to summarize participant characteristics and hormonal profiles. Continuous variables such as age and hormone levels were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

Inferential statistical analysis was performed to examine associations between hormonal abnormalities and infertility characteristics. The chi-square test was used to evaluate relationships between categorical variables, including hormonal status and type of infertility. Independent sample t-tests were used to compare mean hormone levels between relevant groups where applicable. Correlation analysis was performed to explore relationships between hormone levels and selected clinical variables. A p-value of less than 0.05 was considered statistically significant.

Ethical approval for the study was obtained from the institutional ethical review authority of the participating hospital prior to data collection. All procedures were conducted in accordance with ethical principles governing human research, including confidentiality of participant information and secure handling of clinical data. Participant identifiers were removed from the dataset during analysis to ensure privacy and maintain data integrity. The study protocol, data collection methods, and analytical procedures were documented in detail to allow reproducibility and transparency in the research process.

## RESULTS

A total of 157 infertile women attending the gynecology and infertility outpatient clinics of Lady Willingdon Hospital, Lahore were included in the analysis. The demographic, clinical, and hormonal characteristics of participants were examined using descriptive and inferential statistical approaches.

*Table 1 Prevalence of Infertility Type among Study Participants (n = 157)*

| Type of Infertility | Frequency (n) | Percentage (%) |
|---|---|---|
| Primary infertility | 91 | 58.0 |
| Secondary infertility | 66 | 42.0 |
| Total | 157 | 100 |

Primary infertility represented the majority of cases in the study population. Out of 157 women, 91 (58.0%) were diagnosed with primary infertility, whereas 66 (42.0%) had secondary infertility. This distribution indicates that more than half of the participants had never achieved a previous pregnancy.

*Table 2 Lifestyle and Behavioral Risk Factors among Infertile Women (n = 157)*

| Risk Factor | Frequency (n) | Percentage (%) |
|---|---|---|
| High BMI / Overweight | 35 | 22.6 |
| Alcohol consumption | 35 | 22.6 |
| Obesity | 13 | 8.1 |
| No significant lifestyle risk | 74 | 46.7 |
| Total | 157 | 100 |

Lifestyle-related risk factors were present in a substantial proportion of the study population. Overweight status was observed in 22.6% (n = 35) of participants, while obesity accounted for 8.1% (n = 13). Alcohol consumption was reported by 22.6% (n = 35) of participants. Nearly half of the women (46.7%, n = 74) did not report any significant lifestyle-related risk factors.

*Table 3 Prevalence of Genital Infections among Infertile Women (n = 157)*

| Infection | Frequency (n) | Percentage (%) |
|---|---|---|
| Ureaplasma urealyticum | 47 | 29.9 |
| Chlamydia trachomatis | 43 | 27.4 |
| Other infections / none detected | 67 | 42.7 |
| Total | 157 | 100 |

Genital infections were commonly observed among infertile women in the study population. Ureaplasma urealyticum infection was detected in 29.9% (n = 47) of participants, while Chlamydia trachomatis was identified in 27.4% (n = 43). The remaining 42.7% (n = 67) either had other infections or showed no detectable infection.

*Table 4 Hormonal Profile Distribution among Infertile Women (n = 157)*

| Hormonal Status | Frequency (n) | Percentage (%) |
|---|---|---|
| Normal FSH levels | 124 | 79.0 |
| Abnormal FSH levels | 33 | 21.0 |
| Normal LH levels | 106 | 67.7 |
| Abnormal LH levels | 51 | 32.3 |
| Normal Estradiol levels | 116 | 74.2 |
| Abnormal Estradiol levels | 41 | 25.8 |

Hormonal assessment demonstrated that 21.0% (n = 33) of participants exhibited abnormal follicle-stimulating hormone levels, indicating potential ovarian reserve abnormalities. Elevated or abnormal luteinizing hormone levels were observed in 32.3% (n = 51) of participants, suggesting possible ovulatory dysfunction or PCOS-related endocrine disturbances. Abnormal estradiol levels were detected in 25.8% (n = 41) of participants.

*Table 5 Mean Hormonal Levels among Infertile Women (n = 157)*

| Hormone | Mean ± SD | Reference Range |
|---|---|---|
| FSH (IU/L) | 6.84 ± 5.41 | 3–10 IU/L |
| LH (IU/L) | 12.44 ± 10.99 | 2–12 IU/L |
| Estradiol (pg/mL) | 12.59 ± 6.21 | 10–50 pg/mL |
| LH/FSH Ratio | 1.8 | <1.5 |

The mean follicle-stimulating hormone level among participants was 6.84 ± 5.41 IU/L, which largely fell within the expected follicular phase range. However, the mean luteinizing hormone concentration was relatively elevated at 12.44 ± 10.99 IU/L, resulting in an LH/FSH ratio of approximately 1.8, which exceeds the commonly accepted threshold associated with polycystic ovarian syndrome. Mean estradiol levels were 12.59 ± 6.21 pg/mL, indicating variable follicular activity across participants.

*Table 6 Age Distribution of Infertile Women (n = 157)*

| Age Group (years) | Frequency (n) | Percentage (%) |
|---|---|---|
| 20–25 | 41 | 26.1 |
| 26–30 | 52 | 33.1 |
| 31–35 | 39 | 24.8 |
| 36–40 | 25 | 16.0 |
| Total | 157 | 100 |

The largest proportion of infertile women fell within the 26–30 year age group (33.1%), followed by 20–25 years (26.1%) and 31–35 years (24.8%). Women aged 36–40 years accounted for 16.0% of the study population.

*Table 7 Association of Hormonal Imbalance with Infertility Type*

| Hormonal Status | Primary Infertility n (%) | Secondary Infertility n (%) | Odds Ratio | 95% CI | p-value |
|---|---|---|---|---|---|
| Normal hormone profile | 60 (65.9) | 41 (62.1) | Reference | — | — |
| Hormonal imbalance | 31 (34.1) | 25 (37.9) | 1.18 | 0.60 – 2.31 | 0.62 |
| Total | 91 | 66 | | | |

The association between hormonal imbalance and infertility type was examined using the chi-square test. Hormonal abnormalities were observed in 34.1% of women with primary infertility and 37.9% of those with secondary infertility. Statistical analysis revealed no significant association between hormonal imbalance and infertility type ($\chi^2 = 0.24$, $p = 0.62$). The calculated odds ratio indicated a modest but non-significant increase in hormonal abnormalities among women with secondary infertility compared with primary infertility.

## DISCUSSION

The present study evaluated the prevalence and patterns of hormonal abnormalities among infertile women attending a tertiary care hospital in Lahore, Pakistan. The findings demonstrate that endocrine disturbances are relatively common among women seeking infertility care, with notable abnormalities observed in luteinizing hormone, follicle-stimulating hormone, and estradiol profiles. Primary infertility was the predominant presentation in the study population, accounting for 58% of cases, indicating that many women attending infertility clinics had not previously achieved conception. This pattern is consistent with epidemiological studies reporting that primary infertility remains a major reproductive health challenge in many developing countries due to delayed clinical consultation, endocrine disorders, and underlying reproductive pathologies (15).

Hormonal assessment revealed that approximately one-third of participants exhibited abnormal luteinizing hormone levels, while abnormalities in follicle-stimulating hormone and estradiol were observed in smaller proportions of participants. Elevated LH levels and an increased LH/FSH ratio are well-recognized endocrine features associated with ovulatory dysfunction, particularly in women with polycystic ovarian syndrome. Previous clinical investigations have similarly reported significant alterations in gonadotropin levels among infertile women, highlighting the importance of hormonal profiling in infertility evaluation (5,13). Studies comparing hormonal levels between women with PCOS and non-PCOS infertility have demonstrated that increased LH concentrations and altered gonadotropin ratios may disrupt follicular maturation and ovulation, thereby contributing to reproductive failure (7).

The mean hormonal values observed in the current study further support the presence of endocrine dysregulation in a subset of infertile women. The mean LH level was relatively elevated compared with the expected follicular phase range, producing an LH/FSH ratio of approximately 1.8. Similar hormonal patterns have been reported in clinical studies examining reproductive hormone profiles among infertile women, where elevated LH levels were associated with ovulatory disorders and PCOS-related infertility (8,17). Such findings emphasize the role of gonadotropin imbalance in disrupting ovarian physiology and highlight the diagnostic importance of evaluating LH and FSH concentrations during infertility assessment.

Thyroid dysfunction and hyperprolactinemia have also been widely recognized as endocrine causes of infertility. Although thyroid and prolactin levels were not the primary focus of the present analysis, previous studies have demonstrated significant correlations between thyroid hormones, prolactin levels, and reproductive dysfunction. Hypothyroidism can interfere with ovulation, menstrual regularity, and implantation, while hyperprolactinemia may suppress gonadotropin-releasing hormone secretion and inhibit ovulation (1,11). Clinical research has shown that thyroid abnormalities and elevated prolactin levels are frequently observed among infertile women, underscoring the importance of including these hormonal parameters in infertility screening protocols (14,16).

Lifestyle factors may also influence reproductive hormone balance and fertility outcomes. In the present study, overweight status and obesity were identified among a proportion of participants. Previous investigations have demonstrated that increased body mass index can contribute to hormonal imbalance through mechanisms such as insulin resistance, hyperandrogenism, and altered gonadotropin secretion (3). Obesity-associated endocrine disturbances have been shown to negatively affect ovulation and fertility, particularly in women with PCOS, suggesting that lifestyle interventions may play an important role in fertility management strategies.

The findings of this study also highlight the potential interaction between infectious diseases and infertility. Genital infections such as Ureaplasma urealyticum and Chlamydia trachomatis were detected in a considerable proportion of participants. These infections are known to contribute to infertility through inflammatory damage to reproductive tissues, including the fallopian tubes and endometrium. Previous cross-sectional studies investigating hormonal imbalance and infectious diseases among infertile women have reported similar findings, indicating that both endocrine and infectious factors may coexist and contribute to infertility in clinical populations (18).

Despite the presence of hormonal abnormalities among participants, statistical analysis did not demonstrate a significant association between overall hormonal imbalance and infertility type. Hormonal abnormalities were observed in both primary and secondary infertility groups, suggesting that endocrine disturbances may contribute to infertility regardless of prior pregnancy history. This observation is consistent with previous reproductive endocrinology studies reporting that hormonal disorders such as PCOS, thyroid dysfunction, and hyperprolactinemia may occur in women with both primary and secondary infertility (2,19).

Several limitations should be considered when interpreting the results of this study. The cross-sectional design limits the ability to establish causal relationships between hormonal abnormalities and infertility outcomes. Additionally, the study was conducted in a single tertiary care hospital, which may limit the generalizability of findings to broader populations. Hormonal measurements were obtained at a single time point, and variations in hormonal fluctuations across the menstrual cycle may influence observed values. Nevertheless, the study provides valuable insights into the hormonal patterns observed among infertile women in a clinical setting and highlights the importance of endocrine evaluation in infertility assessment.

Overall, the results emphasize the role of hormonal assessment in identifying potential endocrine causes of infertility. Comprehensive hormonal screening, combined with clinical and imaging evaluation, may

improve diagnostic accuracy and support the development of targeted therapeutic strategies for infertile women.

## CONCLUSION

The present study demonstrates that hormonal abnormalities are relatively common among infertile women attending a tertiary care hospital in Lahore, Pakistan. Elevated luteinizing hormone levels and altered gonadotropin ratios were among the most frequently observed endocrine disturbances, suggesting a substantial contribution of ovulatory dysfunction to infertility in the study population. Although hormonal imbalance was observed in both primary and secondary infertility groups, no statistically significant association was identified between overall hormonal abnormalities and infertility type. These findings highlight the importance of comprehensive hormonal evaluation in the clinical assessment of infertile women and emphasize the need for further large-scale studies to better understand the endocrine mechanisms underlying infertility and to guide effective diagnostic and therapeutic interventions.

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